

CHILDREN MONITORING SYSTEM USING RADIO FREQUENCY (RF) TECHNOLOGY

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ABSTRAK

Sistem Pemantauan kanak-kanak (CMS) adalah peranti prototaip yang dibangunkan untuk mewakili idea asal yang dicadangkan iaitu sepasang alat yang direka untuk kanak-kanak dan ibu bapa di mana ia boleh mengurangkan kebimbangan ibu bapa akan kehilangan anak-anak mereka sementara membeli-belah dipusat membeli-belah. Ia juga memastikan keselamatan untuk mencegah kehilangan kanak-kanak itu apabila di tempat-tempat awam. Ini adalah kerana produk ini adalah berdasarkan kepada keadaan di mana kehilangan kanak-kanak berlaku apabila sedang membeli-belah atau di kawasan tumpuan ramai. Teknologi yang digunakan untuk prototaip ini adalah Radio Frekuensi (RF). Menurut Alina et al. (2010), radio frekuensi merujuk kepada arus ulang alik (AC) yang memegang unsur itu bahawa, jika arus input antena, elektromagnet (EM) dihasilkan sesuai untuk penyiaran dan komunikasi tanpa wayar. Keistimewaan produk untuk projek prototaip ini adalah peranti yang mewakili kanak-kanak boleh mengeluarkan kehilangan isyarat apabila ia mencapai had jarak yang telah ditetapkan iaitu 1.5m. Manakala peranti yang mewakili sebagai ibu atau bapa juga boleh mengeluarkan isyarat bunyi dan memaparkan bahawa "anak-anak yang hilang" di LCD apabila ia mencapai had jarak yang telah ditetapkan. Ini membolehkan, ibu bapa menyedari di mana anak-anak mereka dan terus mendapatkan anak-anak mereka serta dapat mengelakkan daripada kehilangan berlaku.

ABSTRACT

Children Monitoring System (CMS) is a prototype device which is developed to represent how the original idea proposed which is a pair of device that are designed for children and parents where it can reduce the anxiety of the parents will lose their children while shopping at the mall. It also ensures security to prevent the disappearance of the child when in public places. This is because this product is based on the situation in which the loss occurred when the children are shopping or while in a lot of people. Technology used for this prototype is Radio Frequency (RF). According to Alina et al. (2010), radio frequency refers to alternating current (AC) which hold element such that, if the current is input to an antenna, an electromagnetic (EM) field is produce appropriate for wireless broadcasting and communications. Privileges available to product are the device that represent as children may issue loss of signal when it is reach the limitation distance which is 1.5m for this prototype project. While the device that represent as the mother or father also may emit a sound signal beep and display that “kids are missing” at the LCD when it is reach the limitation distance. Currently, parents will know where their children and continue to get their children and aware from any missing occur.

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LIST OF ABBREVIATION

| | | |
|------------|----------|-----------------------------------|
| CMS | = | CHILDREN MONITORING SYSTEM |
| RF | = | RADIO FREQUENCY |

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

The objectives of this study are to produce a prototype device to facilitate the parents/users to keep their children while they were in a shopping mall and public areas. This chapter includes the background, research objectives, problem statement and also relevant information according to research study which is collected from different journals and articles.

As cited in TheStar (2007), children regularly get separated from their parents at shopping malls. Indicate that at least five cases of lost children were reported every month in the shopping mall. Case of lost children in a shopping mall can be said to occur almost every day, not just on weekends all around our country.

Among the identified causes of the cases are often attracted to children and stop at certain parts of the shopping centers such as compact discs store video (VCD) or the center of the game so it was not noticed by their parents. And often, it is the case of adults allowing their children to wander off on their own. This is because the shopping center will be packed with the presence of visitors, leaving the default of parents to control children who are brought.

The child will cry to find their parents missing, and usually will be easily met anyone who approached. If you see security guards in shopping centers they would bring the child to the customer service counter to be informed. But if they meeting with stakeholders or criminals, the fate of these children do not know yet. What things should be done by parents to ensure their children's safety guaranteed?

Child Monitoring System (CMS) is a product which is intended to develop where it can reduce the anxiety of the parents will lose their children while shopping at the mall. It also ensures security to prevent the disappearance of the child when in public places. This is because this product is based on the situation in which the loss occurred when the children are shopping or while in a lot of people.

"CMS" is a pair of device that is designed for children and parents. Technology used for this device is Radio Frequency (RF). According to Alina et al. (2010), radio frequency referring to alternating current (AC) hold elements which is, if the current is input to an antenna, an electromagnetic (EM) field is produced suitable for all wireless broadcasting and communication.

Privileges available to product are the device that represent as children may issue loss of signal when it is reach the limitation distance which is 1.5m for this prototype project. While the device that represent as the mother or father also may emit a sound signal beep and display that "kids are missing" at the LCD when it is reach the limitation distance. Currently, parents will know where their children and continue to get their children and aware from any missing occur.

RF is a term which is always referring to an electrical oscillation, as opposed to a mechanical oscillation. However, it is important to note that mechanical systems of this type do indeed exist (as cited in Smith et al. 2005). There is lots of types of wireless devices that used of RF areas. With this, parents will know the location of their children. Sound on the bracelet worn by the children will sound aloud when their parents approach their children. This product may have a high potential market for many parents with small children want to ensure the safety of their children.

With the emergence of “CMS”, hopes that cases of lost children can be reduced. Even it can help parents with small children to supervise their children during the busy shopping at malls or in the focus areas of the public. This tool can also warn parents about the conditions of their children if parents are busy in the shopping mall for example, when their children play away from their parents.

1.2 PROBLEM STATEMENT

The problem statements of this project are:-

- Parents difficult to monitor their children when they are busy shopping or at public area.
- The disappearance of the child at the public's attention often occurs.
- Difficulties in finding the children who escaped from the supervision.

1.3 OBJECTIVES

The objective of this project is:-

- To develop a prototype project that can help to assist user in detect a missing children.
- To create a pair of device used RF technology that can detect each of devices which is will emit a sound and LED signal when it reach the distance limit.
- To help user to prevent from any missing and aware from any missing occur in limitation distance.

1.4 SCOPE

The scope of this project include:-

Technology

- RF referring to radio frequency, which is any frequency within the electromagnetic spectrum associated with radio wave propagation. When an RF current is supplied to an antenna, an electromagnetic area is created that then is able to broadcast through space. Many wireless technologies are based on RF area propagation.

User

- This project is actually developed for parents that want to secure their children in a crowded area such as shopping complex. But for this prototype project design, the user is students and lecturer who will evaluate and make the project testing.

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1.5 THESIS ORGANIZATION

This thesis consists of four (4) chapters. Chapter 1: Introduction briefly describes and introduces the system. This system preliminary shows the basic concept of the system, problem statements of the system, objectives, scopes, and how the report is organized. Chapter 2: Literature Review depicts the manual systems and the existing systems as the case studies of the project. This chapter also reviews the technique, method, equipment, and technology that had been used in the case studies. Chapter 3: Methodology discusses about the overall workflow in the development of the project. This chapter also discusses the method, technique or approach that has been used while designing and implementing the project. Chapter 4: Conclusion briefly summarizes the project.

CHAPTER II

LITERATURE REVIEW

This chapter briefly describes the review on existing techniques related with the proposed project. This chapter comprises three sections. The first section describes some brief information on Radio Frequency (RF), RF spectrum and RF applications. The second describes Applications of RF in Detection, while the last section describes the review on method, equipment, and technology previously used in the same domain.

2.1 RF

RF term refer to Radio Frequency. Radio Frequency usually referring to a rate of oscillation that takes place between range of 30 kHz to 300 Ghz. These correspond is used to transmit and receive radio waves to a special frequency that, which is where the name comes from (Patil et al. 2005). Many wireless technologies are referring to RF field propagation.

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According to Rouse, 2006, wireless usually refers to describe telecommunications where electromagnetic waves transmit the signal over part or the entire communication path. Some monitoring devices, such as intrusion alarms, employ acoustic waves at frequencies above the range of human hearing. These are also sometimes categorized as wireless.

On early 20th century, the first wireless transmitters went on the air in the by using radiotelegraphy or usually known as Morse code. The medium came to be called "radio" after that as inflection made it possible to transmit voices and music via wireless. The term "wireless" has been resurrected by way of the arrival of television, fax, data communication, and the efficient use of a larger segment of the spectrum (as cited in Rouse, 2006).

Wireless technology is hastily evolving, and is playing a growing part in the lives of people all the way through the world. Besides, ever-larger numbers of people are relying on the technology directly or indirectly. Examples of wireless communications and control consist of:

- Global System for Mobile Communication (GSM) which is a digital mobile telephone system used in Europe and other parts of the world.
- General Packet Radio Service (GPRS) which is a packet-based wireless communication service that provides continuous connection to the Internet for mobile phone and computer users.
- Enhanced Data GSM Environment (EDGE) which is a faster version of the Global System for Mobile (GSM) wireless service.
- Universal Mobile Telecommunications System (UMTS) which is a broadband, packet-based system offering a consistent set of services to mobile computer and phone users no matter where they are located in the world.

- Wireless Application Protocol (WAP) which is a set of communication protocols to standardize the way that wireless devices, such as cellular telephones and radio transceivers, can be used for Internet access.
- i-Mode which is the world's first "smart phone" for Web browsing, first introduced in Japan that provides color and video over telephone sets.

Wireless term can be divided to:

- I. Fixed wireless - the operation of wireless devices or systems in homes and offices, and in particular, equipment connected to the Internet via specialized modems
- II. Mobile wireless - the use of wireless devices or systems aboard motorized, moving vehicles. Examples include the automotive cell phone and Personal Communications Services (PCS).
- III. Portable wireless - the operation of autonomous, battery-powered wireless devices or systems outside the office, home, or vehicle; examples include handheld cell phones and PCS units.
- IV. IR wireless - the use of devices that convey data via IR (infrared) radiation which is employed in certain limited-range communications and control systems.

There are lots of services that operates in RF spectrum such as cordless and cellular telephone, radio and television broadcast stations, satellite communications systems, and two-way radio services. Some wireless devices operate at IR usually known as visible-light frequencies, which is electromagnetic wave lengths are shorter than those of RF fields. Television-set remote-control boxes, some cordless computer keyboards and mice, and a few wireless hi-fi stereo headsets are most known example for this technology (as cited in Rouse, 2008).

It gives rise to an electromagnetic field that propagates through space once an RF current is supplied to an antenna. This field is sometimes called

an RF field, in less technical terminology it is a "radio wave." Any RF field has a wave length that is inversely proportional to the frequency. In the atmosphere or in outer space, s is the wavelength in meters and f is the frequency in megahertz, so :

$$s = 300/f$$

The frequency of an RF signal is inversely comparative to the wavelength of the EM field to which it corresponds. At 9 kHz, the free-space wavelength is around 33 kilometers (km) or 21 miles (mi). At the highest radio frequencies, the EM wavelengths measure approximately one millimeter (1 mm). As the frequency is increased beyond that of the RF spectrum, EM energy takes the form of infrared (IR), visible, ultraviolet (UV), X rays, and gamma rays.

For an oscillating or varying current, frequency is the number of complete cycles per second in alternating current direction. The standard unit of frequency is the hertz, abbreviated Hz. The standard alternating-current utility frequency in some country if a current completes one cycle per second, then the frequency is 1 Hz, 60 cycles per second equals 60 Hz.

Larger units of frequency include the kilohertz (kHz) represents thousands (1,000's) of cycles per second, the megahertz (MHz) represents millions (1,000,000's) of cycles per second, and the gigahertz (GHz) represents billions (1,000,000,000's) of cycles per second. Occasionally the terahertz (THz) is used; 1 THz = 1,000,000,000,000 cycles per second. Note that these prefixes represent specific powers of 10, in contrast to the prefix for multiples of bytes, which represent specific powers of 2.

Distance between identical points in the adjacent cycles of a wave form signal propagated in space or along a wire, is known as wavelength. In wireless systems, this length is usually specified in meters, centimeters, or millimeters. In the case of infrared, visible light, ultraviolet, and gamma

radiation, the wavelength is more often specified in nanometers (units of 10^{-9} meter) or Angstrom units (units of 10^{-10} meter).

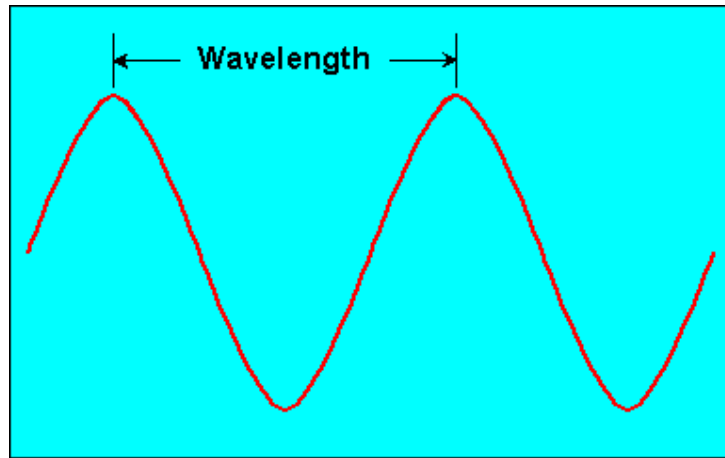


Figure 2.1.1 – Wavelength

Wavelength is related to frequency. The higher the wavelength of the signal, then the shorter the frequency. If f is the frequency of the signal as measured in megahertz, and w is the wavelength as measured in meters, then

$$w = 300/f$$

and conversely

$$f = 300/w$$

The RF spectrum is divided into several ranges, or bands. With the exception of the lowest-frequency segment, each band representing the increase of frequency corresponding to an order of magnitude (power of 10). The table depicts the eight bands in the RF spectrum, showing frequency and bandwidth ranges. The SHF and EHF bands are often referred to as the microwave spectrum (as cited from Rouse, 2008).

Table 2.1.1 : RF frequencies and properties (as cited from Rouse, 2008)

| Designation | Abbreviation | Frequencies | Free-space Wavelengths |
|-------------|--------------|-------------|------------------------|
| | | | |

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|-----------------------------|-----|------------------|----------------|
| 1. Very Low Frequency | VLF | 9 kHz - 30 kHz | 33 km - 10 km |
| 2. Low Frequency | LF | 30 kHz - 300 kHz | 10 km - 1 km |
| 3. Medium Frequency | MF | 300 kHz - 3 MHz | 1 km - 100 m |
| 4. High Frequency | HF | 3 MHz - 30 MHz | 100 m - 10 m |
| 5. Very High Frequency | VHF | 30 MHz - 300 MHz | 10 m - 1 m |
| 6. Ultra High Frequency | UHF | 300 MHz - 3 GHz | 1 m - 100 mm |
| 7. Super High Frequency | SHF | 3 GHz - 30 GHz | 100 mm - 10 mm |
| 8. Extremely High Frequency | EHF | 30 GHz - 300 GHz | 10 mm - 1 mm |

Before radio communication can be received, it is necessary to have an antenna in place to pick it. Yet, it will pick up at the exact same time during use, a tuner is needed to narrow down the source of the signal, since an antenna cannot distinguish between lots of signals (as cited from Walker, 2010).

To help you to tune into a specific frequency, a tuner can be used which will in turn help you control what "channel" you are dialing into and picking up with your antenna. The tuner always makes use of a resonator that amplifies oscillations of the preferred frequency to a point where they are distinguishable over the rest of the "noise" (as cited from Walker, 2010).

In the medical field, RF energy is also used. Example of RF used for medical field such as some minimally invasive surgeries that make use of RF

energy for coagulation and radio frequency ablation. This technology can be used to treat conditions such as sleep apnea (as cited from Walker, 2010).

RF electrical currents also display a very interesting set of properties. For example, RF currents can ionize air and create conductive paths right through it. Another example is how RF electrical currents travel along the surface of conductors instead of penetrating through or the "skin effect" (as cited from Walker, 2010).

2.2 Applications of RFID in Detection

2.2.1 Asset Tracking via Robotic Location Crawling

Reference: Patil, Munson, Wood & Cole. (2005). "BlueBot: Asset Tracking via Robotic Location Crawling". *IBM Research Report*.

Asset Tracking via Robotic Location Crawling represents a prototype automatic location sensing-system that combines RFID technology and off-the-shelf Wi-fi based continuous positioning technology for asset tracking in indoor environments. The system employs a robot, with an attached RFID reader, which periodically crawls the space, associating items it detects with its own location determined with previous samples to compute its location. Asset tracking knowing what user have and where it is located. It is essential for the smooth operation of large manufacturing companies. It also assists big retailers isolate bottlenecks in their supply chain, reduce overstocking or locate spoiled cargo.

Automatic location sensing is the key to enabling such tracking applications. One of the most well-known positioning system is GPS, which relies on satellites to track location. However, due to its dependence on satellites, GPS lacks the ability to exactly determine location inside buildings. Steggles and Cadman (2010) provide a good comparison of various RF-tag-based location sensing technologies. Many of the current location sensing system are radio based (Wi-fi, Bluetooth). By using base station visibility and signal strength or time of flight, it is possible to locate Wi-fi devices with an accuracy of several meters. Normally, these systems use an ultrasound time-of-flight measurement technique to provide location information. Most of them share a significant advantage, which is the overall accuracy.

The asset tracking technologies mentioned above are mostly geared towards tracking items that individually have high value. These items require continues tracking and justify the use of the expensive tracking equipment. However, in many tracking applications (e.g. the library scenario described earlier) the object being tracked is either too small or too low value to justify the use of a tracking system with high per-item cost. There are many applications where it is valuable to know the precise location of an asset, yet it is permissible for an asset's location to be updated on a periodic basis.

Table 2.2.1 – Tracking System Taxonomy

| | | Continuous in Space | |
|--------------------|-----|---|---|
| | | YES | NO |
| Continuous in Time | YES | GPS, TDOA, EOTD, Wi-Fi signal strength, etc. | Simple “presence” technologies (e.g., cellular system where cellID is reported as the cellphone’s location) |
| | NO | BlueBot | Fixed Beacon (e.g., EZPass, Bluetooth) |

2.2.2. RFID-Based Techniques For Human-Activity Detection

Reference : Smith, Fishkin, Jiang, Mamishev, Philipose, Rea, Roy & Rajan (2005). RFID-Based Techniques For Human-Activity Detection. *COMMUNICATIONS OF THE ACM*, (Vol. 48, No. 9).

In spite of this daunting RFID limitation for tracking human activity, there are two very different approaches, both based on RFID have been pursue for this research. The iBracelet is a wrist-worn short-range RFID reader that detects object use via hand proximity. The Wireless Identification and Sensing Platform (WISP) is a family of long-range RFID tags amplified with sensors that detect object motion, they eliminate the need to wear something by moving from short-range tags matched with wearable readers to long-range motion sensitive tags read by fixed infrastructure.

While both approaches modify and extend conventional RFID, neither requires batteries in the objects being tracked. WISPs deliver the motion detection capabilities of active sensor beacons in the same battery-free form factor as RFID tags using line powered readers.

The iBracelet system uses just one battery to power its wrist-worn reader and yields information about who is using particular objects not directly available through the WISP approach. The wearable reader also gives the subjects being monitored more control over the system, since users can more conveniently disable it-by taking it off-than user have with the fixed-reader infrastructure, iGlove. Glove have been created in 2003 as part of first effort to track object use with RFID. While the early prototype was too crude for true long-term deployment, it was usable and durable enough that were able to enlist 14 volunteers to wear it while